Effects on native plant regeneration and understory community response after post-fire seeding with *Lolium multiflorum* in a ponderosa pine forest in northern Arizona

(preliminary data)

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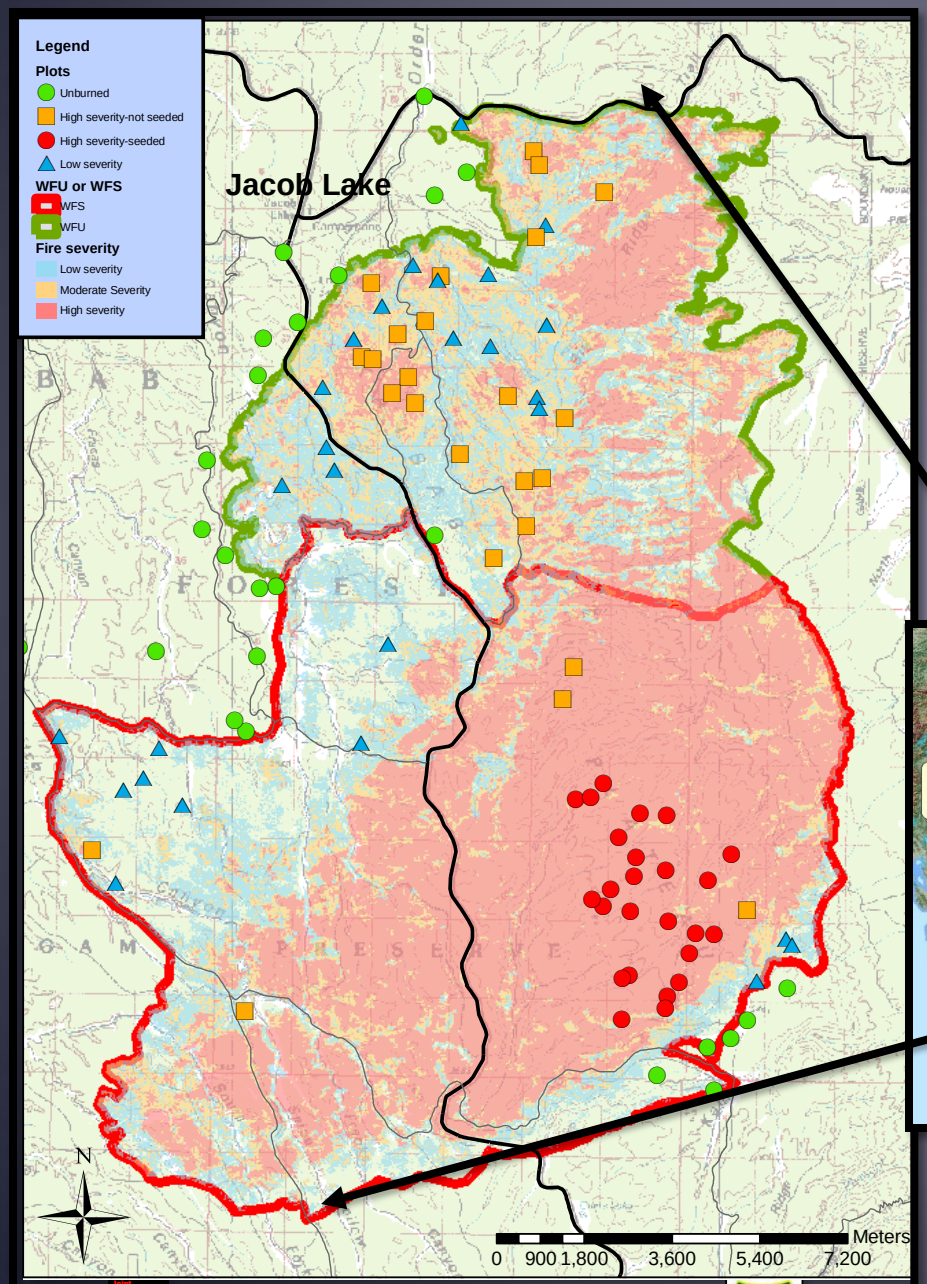
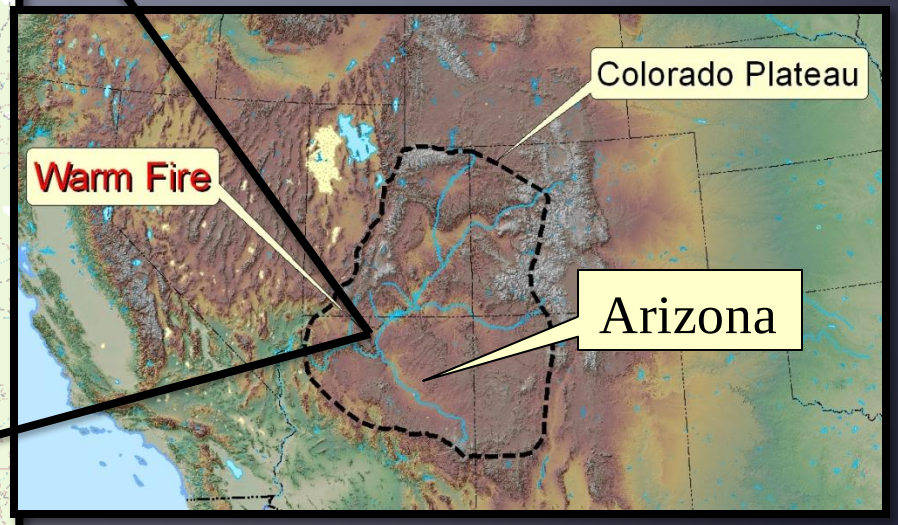
Warm Fire


Legend
Plots
Unburned
High severity-not seeded
High severity-seeded
Low severity
WFU or WFS
WFS
WFU
Fire severity
Low severity
Moderate Severity
High severity
Jacob Lake
N
0 900 1,800 3,600 5,400 7,200
Meters


Colorado Plateau
Warm Fire
Arizona

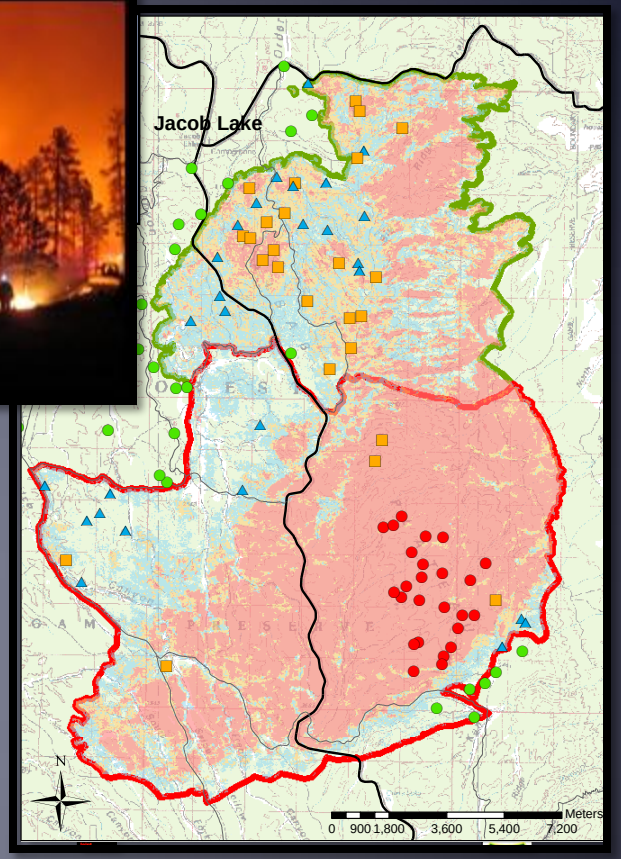
Warm Fire

- June 2006
  - Wildland Fire Use (13,000 ha)
  - Wildland Fire (11,000 ha)
- Mixed severity
- Ecosystems burned

  Pinyon-Juniper: 1,500 ha

  Ponderosa: 18,000 ha

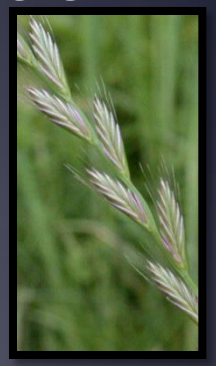
  Mixed conifer: 4,000 ha
- Controversy
  - WFU policy
  - 2x's the acreage
  - Loss of resources
  - Evacuations of Grand Canyon NP



Burned Area Emergency Response (BAER)

- High severity
- Post-fire seeding
- Goal
  - Decrease exotic invasion
  - Soil erosion/stabilization
- *Lolium multiflorum*
  (Annual Rye)
  - Aerial
  - 1.92 L/ha
    (3.5 lbs./acre)

Lolium multiflorum



- Germinates quickly
- Exits the system in 2-3 years
- Sterilized pre-application
- Annual vs. perennial
- Advantages over native vegetation
- Decreases native cover, richness and diversity

Beyers *et al.* 1999, Barclay *et al.* 2004, Keeley *et al* 2006

Research Questions

(2009, High Severity, Seeded and Non-Seeded data only)

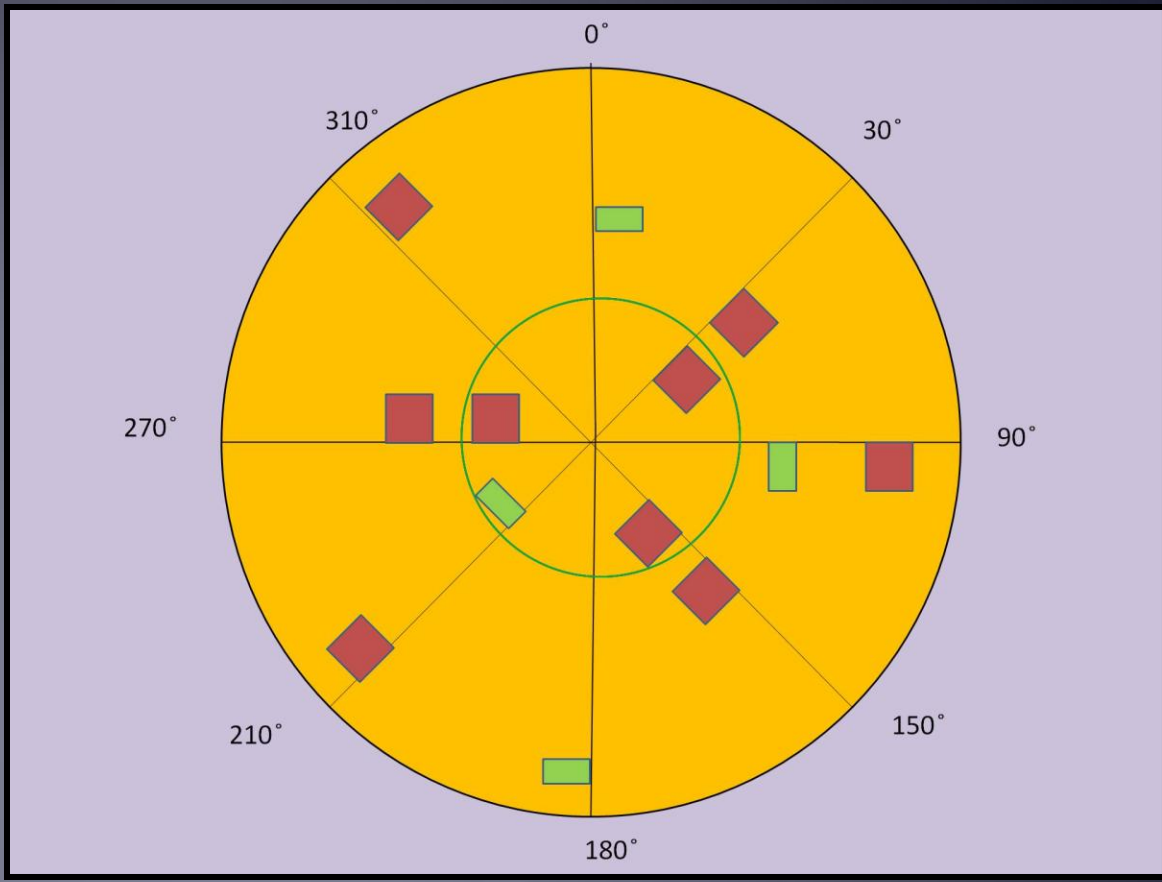
1. Is the *L. multiflorum* still present in the system three years post fire?
2. Was seeding successful in decreasing exotic plant cover and achieve greater total cover?
3. Does the plant community composition differ between seeded and non-seeded sites?
4. Which species are driving these observed differences?

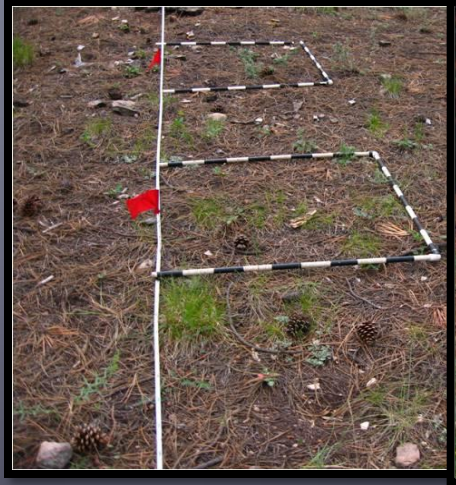
Methods

Methods

Sampled in August 2007-2009

- Plot level data
  - Species richness
  - Canopy cover
  - Conifer seedling
  - Shrubs
- Subplot Data
  - % cover vegetation
  - % cover substrates



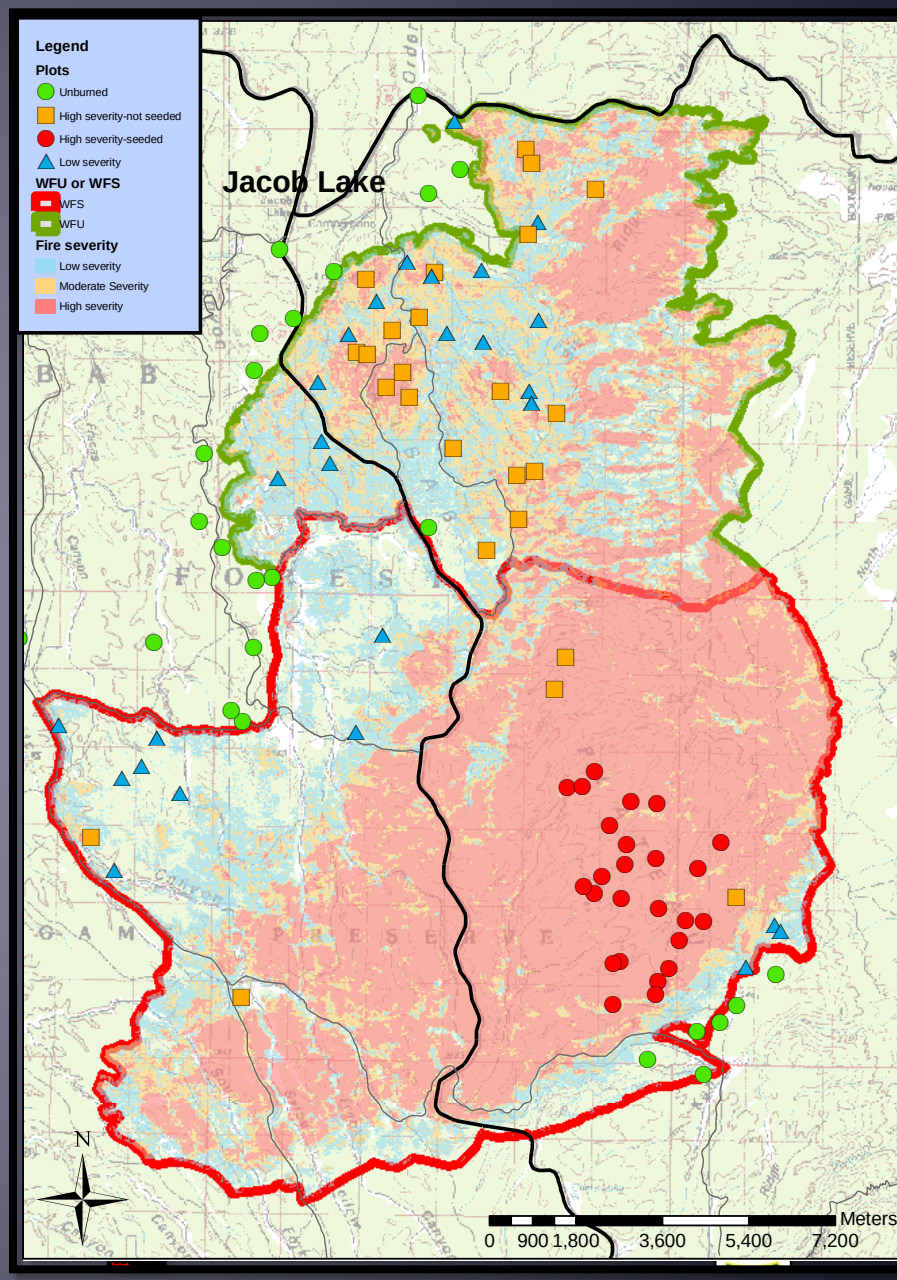


Plot Selection

102 total: 11 pre-fire

Stratification by:

1. Vegetation type- ponderosa pine
2. Soils- Limestone base (mollic eutroboralfs)
3. Fire severity- low and high
4. Elevation- 2300-2540 m
5. Slope- > 30%



Statistical Analysis

PC-ORD V.5.1

- PERMANOVA- community, cover and richness distance based nonparametric analysis of variance

  p=.05 for significance

- Indicator Species Analysis

  p=.05; IV>30 for significance

- NMDS ordinations- show the distribution of mean treatment composition in species space

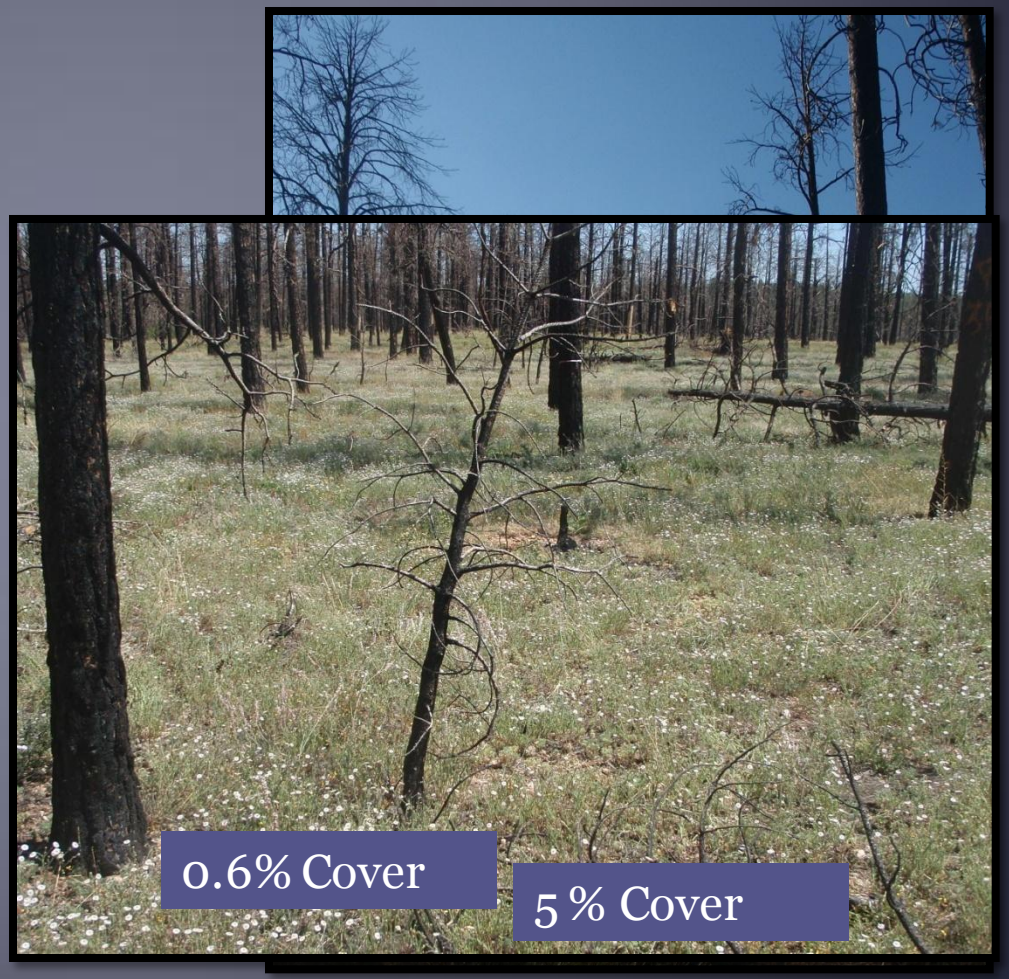
Results

1. Is the Lolium still present in the system three years post fire?

Results:

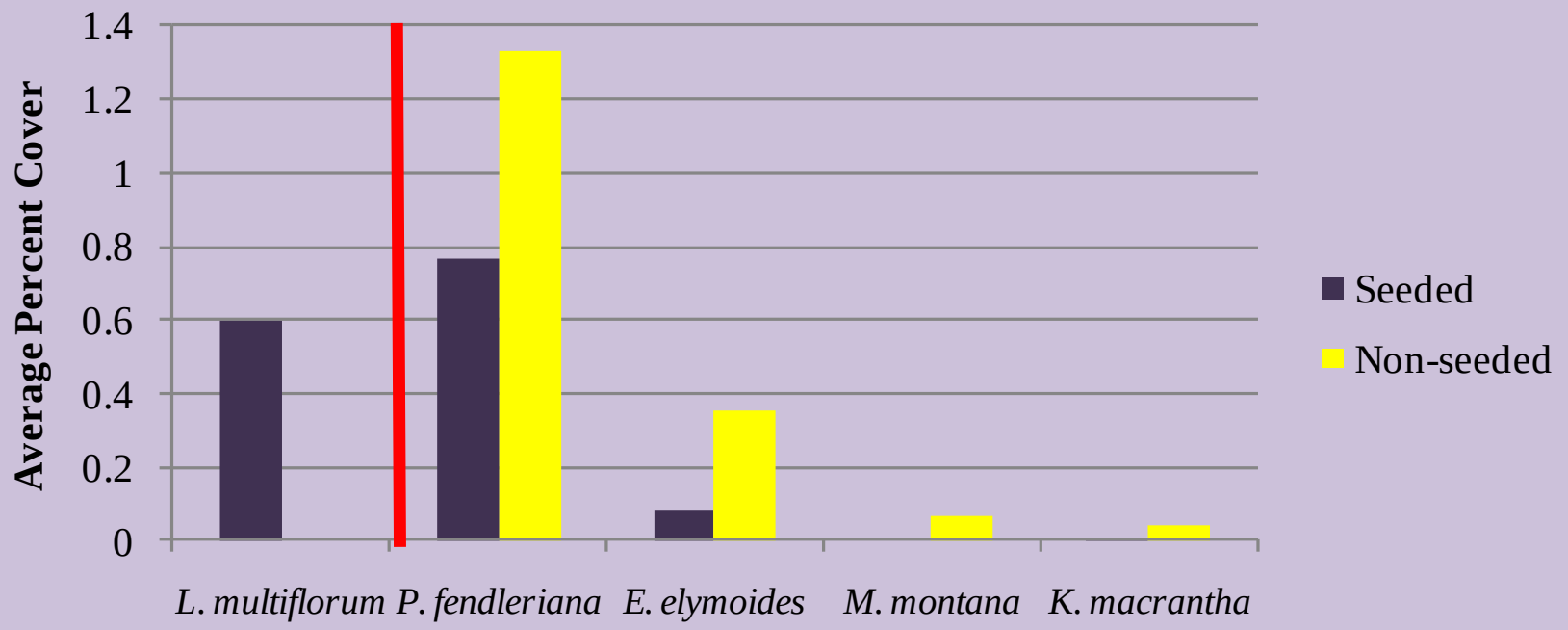
Yes.

- 0-5% cover
- 0.6% Average



How does *Lolium* cover compare with the 4 most common bunch grasses?

Results



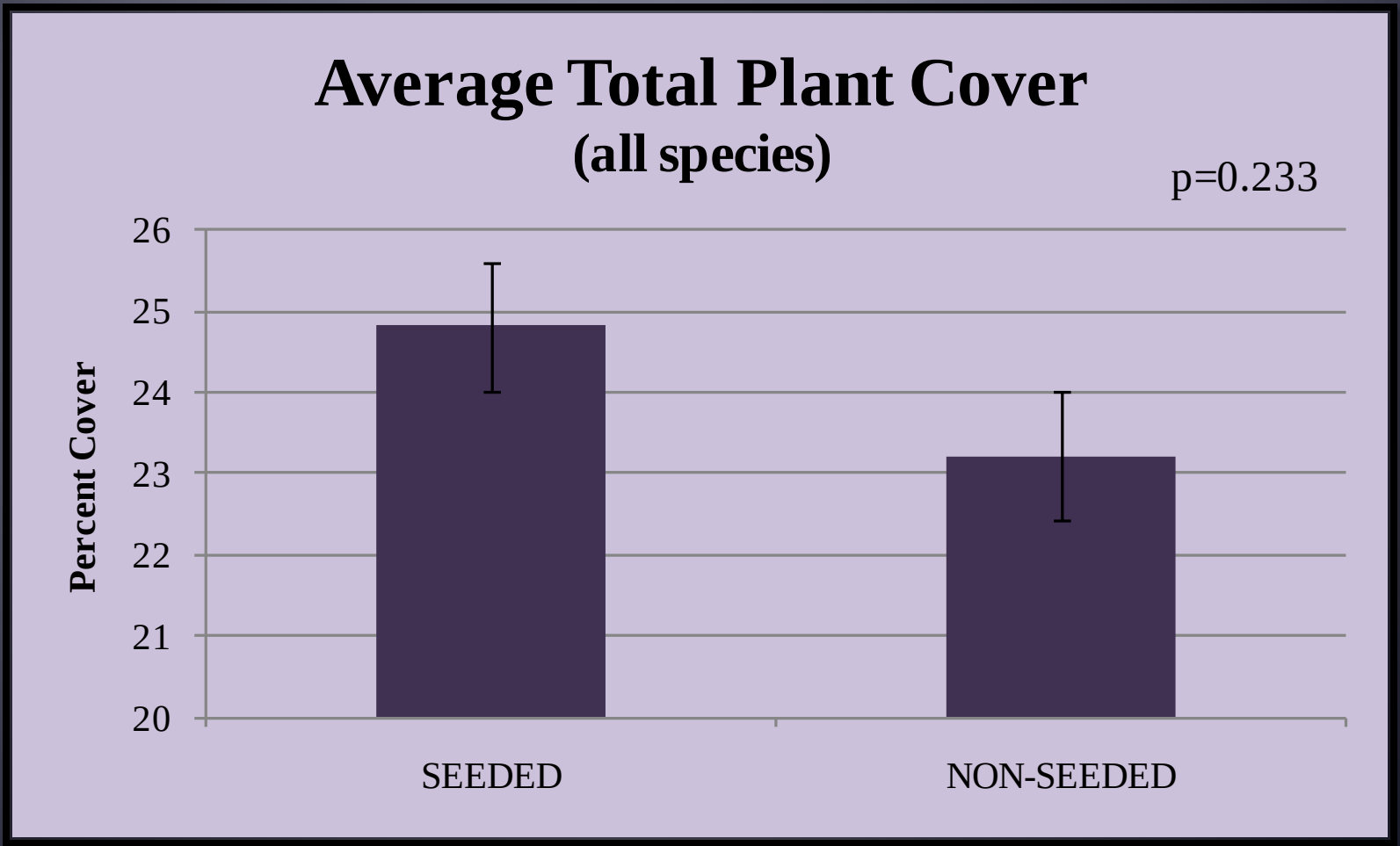
Conclusions-

Is the Lolium still present in the system three years post fire?

1. Yes, and perhaps because:
   - Annual that readily hybridizes with perennial *Lolium spp*.
   - Not all seeds were sterilized prior to application
2. Less cover of native bunch grasses in seeded plots

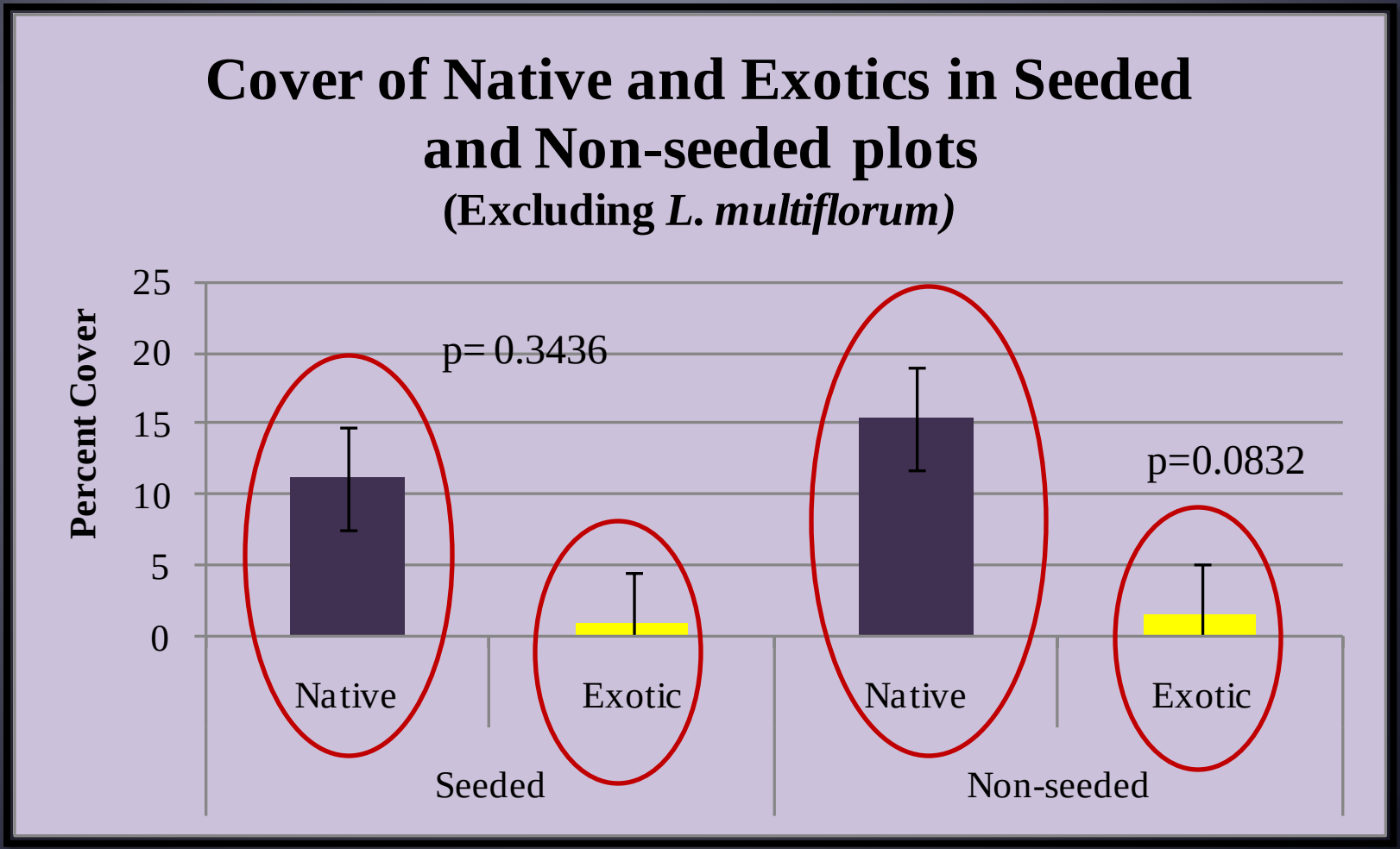
Does total plant cover differ between seeded and non-seeded plots?

Results-



2. Did seeding with ryegrass decrease exotic plant cover?

Results-



Conclusions-

Did seeding with ryegrass decrease exotic plant cover and achieve greater total cover?

1. No difference in total plant cover
2. Seeding did not achieve the goal of decreasing exotics any more than natural recovery

3. Is the community composition different between seeded and non-seeded sites?

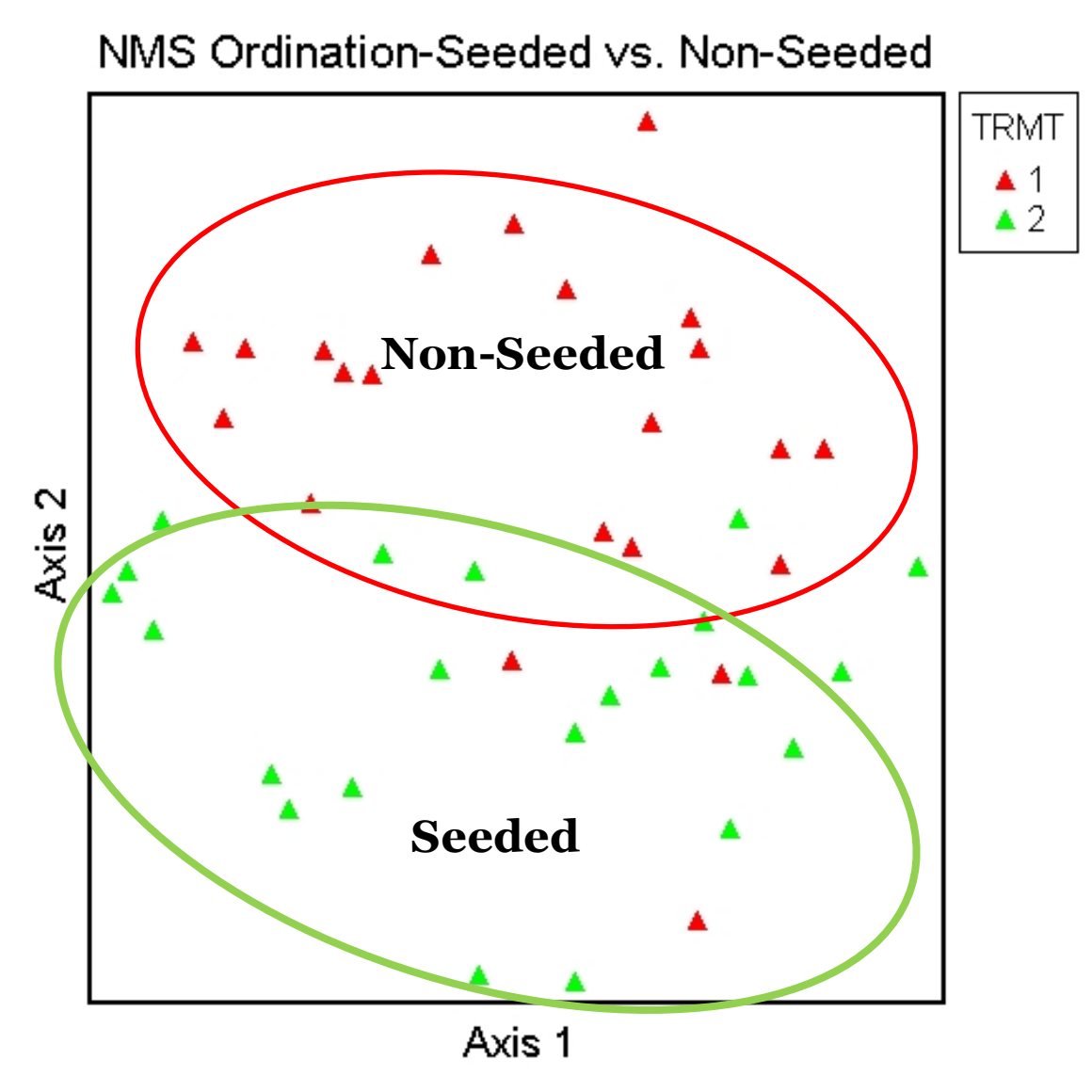
Results

- PERMANOVA
  p=.0012

- NMDS

Final stress:
16.72087

Final instability:
0.0001



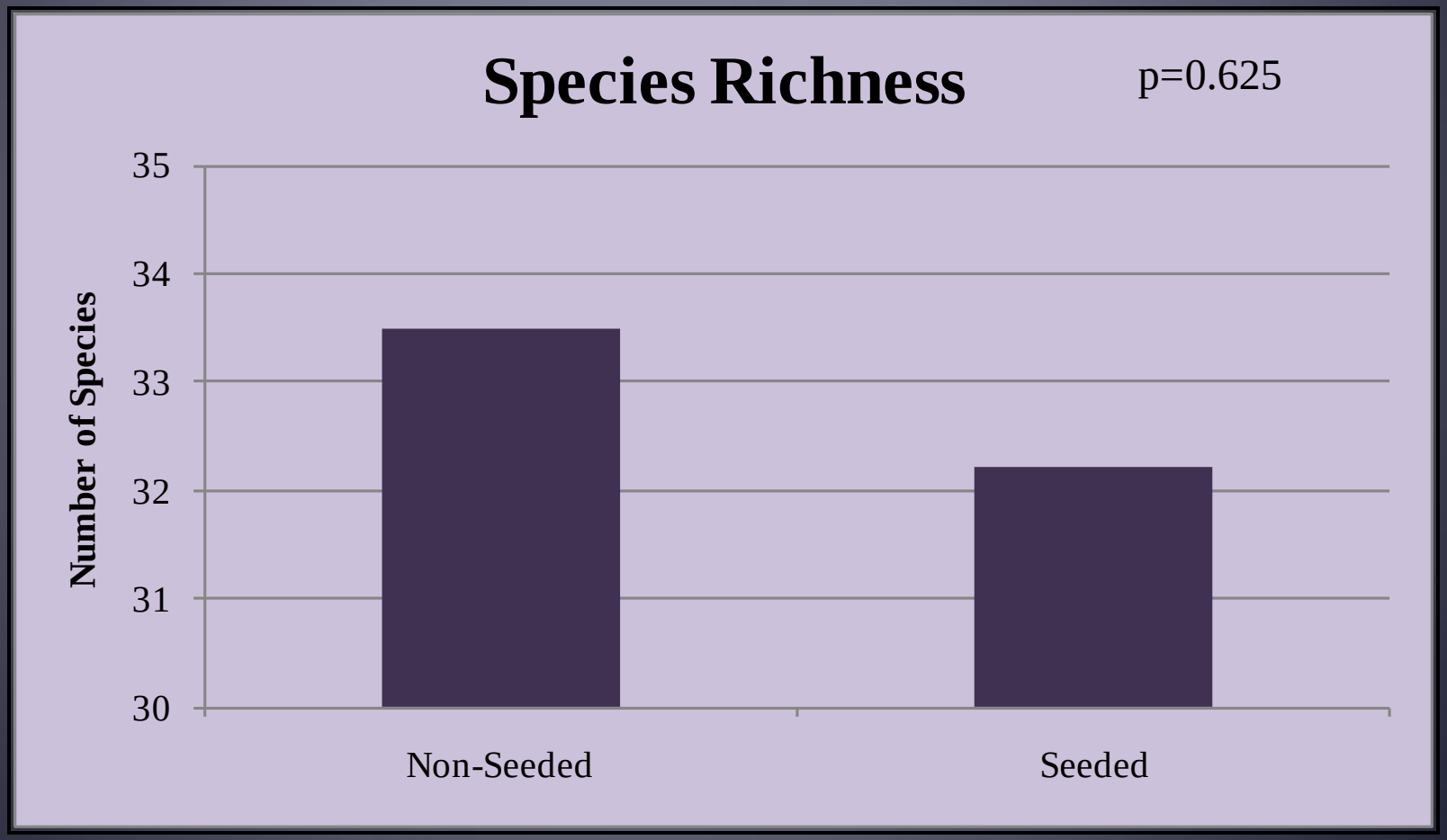
4. Which species are driving these observed differences in community?

Results- Indicator Species Analysis

Non-seeded	Seeded
Achillea millefolium- Yarrow	*Arabis fendleri*- Fendler's rockcress
Antennaria parvifolia- Pussytoes	*Conyza canadensis*- Horseweed
Arenaria lanuginosa- Spreading sandwort	*Erigeron divergens*- Spreading fleabane
Elymus elymoides- Squirreltail	*Hymenopappus filifolius*- Fineleaf hymenopappus
Hieracium fendleri- Yellow hawkweed	*Lolium multiflorum**- Annual ryegrass
Muhlenbergia montana- Mtn. muhly	*Lotus wrightii*- Wright's deervetch
Packera multilobata- Lobeleaf groundsel	
Pinus ponderosa- Ponderosa pine	
Populus tremuloides- Quaking aspen	
Ribes cereum- Wax currant	
*Taraxacum officinale**- Dandelion	
*Verbascum thapsus**- Wolly mullien	

*exotic

Results-
Differences in species richness?



Conclusions-

Is there a difference in the community composition and if so which species are driving those differences?

1. Significantly different and spatially different
2. Fewer indicator species consistently present in seeded plots; less consistent community
3. Increased presence of native bunch grasses and ponderosa pine and aspen in non-seeded
4. Exotics- dandelion and mullein suppressed
5. Species Richness is not significantly different, seeding is not having a dramatic effect on the number of species

Take Home Message

1. *L. multiflorum* may have been effective at decreasing the cover of common exotics wooly mullein and dandelions but.....

2. Goals of seeding were not met:
   - No overall difference in exotic cover
   - No difference in total plant cover

3. Inhibition of recovery of native bunch grasses

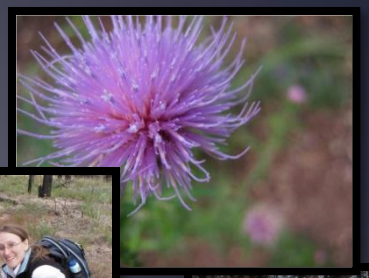
4. Significant competition from the *Lolium* may result in less tree regeneration of ponderosa pine and aspen

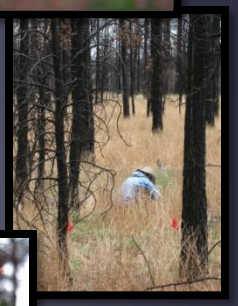
5. *L. multiflorum* is still present in the ecosystem 3 years post-fire and appears to have changed the trajectory of the community composition

Management recommendations

1. Monitor; short and long term
2. Look to previous research done in your region; has seeding achieved goals?
3. Evaluate your site; exotic/rare species of concern?
4. Timing of seeding
5. If seeding, use locally adapted seed
6. Adaptive Management

Acknowledgements





- Joint Fire Science Program
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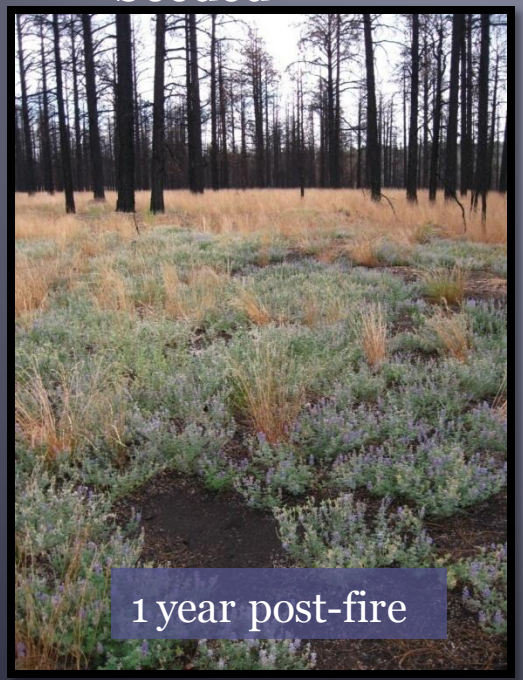
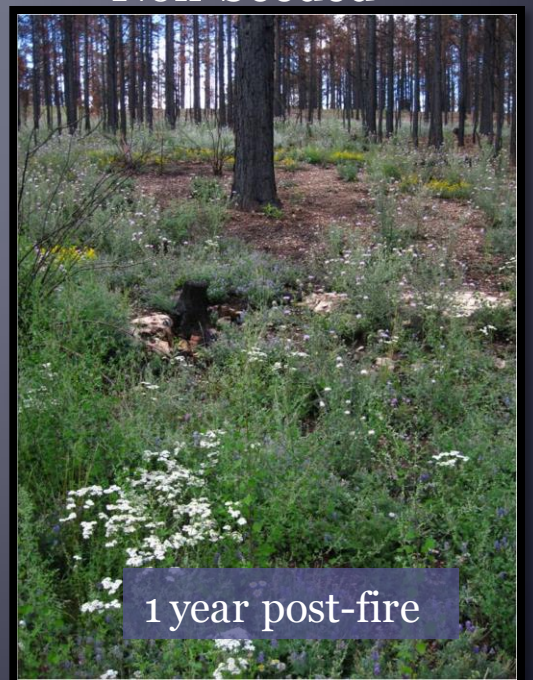
- Northern Arizona University
  - Andrea Thode and Michael Kearsley
- Kaibab National Forest
  - Dave Mertz
- Field Crews
- Lab technicians
- PAPAZ volunteers

Thank you!
Questions?

Research Objective

Characterize the changes in plant community composition across burn severities and with varying post-fire treatments

Seeded



Non-Seeded